* Explain the methods of Consumptive use (Cu)

or

Enlist the various method of Consumptive use (Cu) & explain any one of them

or

Explain any one method of Consumptive use (Cu) given by scientists

or

What is the Consumptive use (Cu) & explain one method to determine the Consumptive use (Cu) of crops

Solⁿ:- – These are mainly four (4) methods to compute the Consumptive use (Cu) of the crop

1 - Blaney - Criddle method
2 - Thronwaite formula / method
3 - Hargreaves method / equation
4 - Penmen Monteith method

1.> Blaney - Criddle method

- This method was given by Blaney & Criddle in 1950
- They found / researched that the Consumptive use (Cu) is the closely related to temperature (monthly avg. temp), day-light hours (monthly) & length of crop growing season
- In short this method is based on the temperature (t), day-light hours (P) & crop growing length
- They gave following expression to find out the Cu (Consumptive use)

$$Cu = \frac{P}{40}(1.8t + 32) \longrightarrow \text{(S.K. Garg)}$$

where Cu = Consumptive use (cm)
P = Monthly day-light hour percentage
t = Monthly average temperature (°c)

- we may also write that

$$Cu = \frac{P}{40}\left(\frac{1.8}{40}t + \frac{32}{40}\right)$$

$$= 0.025P(0.045t + 0.8)$$

$$Cu = \frac{P \times 1.8}{40}\left(t + \frac{32}{1.8}\right)$$

$$= 0.045P\ (t + 17.77)$$

$$Cu \simeq 0.046P\ (t + 17.8)$$

Here, Cu in cm, if we convert it into mm then it is multiply by 10 so,

$$Cu = 0.46P\ (t + 17.8)$$

~~Cu = 0.46~~

$$Cu = P\ (0.46t + 8.188)$$

$$Cu \simeq P\ (0.46t + 8) \longrightarrow \text{(A.M. Michale)}$$

where

Cu = Consumptive use (mm)

t = Monthly avg. temp. (°c)

p = Monthly day-light hour percentage

$$p = \frac{\text{monthly day time hour}}{\text{Total annual day time hour}} \times 100$$

Now,

- From above equation we may say that there is only two factors required namely temp. (t) & day-light hours percentage (p) so, it is very simple method to calculate the consumptive use (Cu) of crop based on only climatic data.

- As above calculated Cu is the PET (Potential evapotranspiration) but we need AET (Actual evapotranspiration) which is given by multiplying the above equation by crop factor (k)

So,

Remember

$$Cu = \frac{K \times P}{40}(1.8t + 32) \rightarrow Cu \text{ in cm}$$

$$Cu = KP(0.46t + 8) \rightarrow Cu \text{ in mm}$$

where K = crop factor, determined by experiments & which may vary from intial stage to the final stage of crop

Ex-2.9 Garg (37) Wheat is to be grown at a certain place, the useful climatological conditions of which are tabulated below

a- Determine the evapotranspiration & Consumptive irrigation requirement of wheat crop.

b- Also determine the field irrigation requirement if the water application efficiency is 80%.

Make use of Blaney-Criddle equation & a crop factor equal to 0.8

Month	Avg. monthly temp. (°c) (t)	Avg. monthly day-light hrs (%) (P)	Effective rainfall (cm) (Re)
NOV.	18	7.20	1.7
DEC.	15	7.15	1.42
JAN.	13.5	7.30	3.01
FEB.	14.5	7.10	2.25

Sol^n:- Note :- Here you can use any formula both of them but kept in mind that one is in-cm & other one is in-mm
Here, ER is given in cm- so, I can use first formula

$K = 0.8$ (given)

- We know that

$$Cu = \frac{K \times P}{40} (1.8t + 32)$$

<u>For NOV</u>

$$Cu/AET = \frac{0.8 \times 7.20}{40} (1.8 \times 18 + 32)$$

$$= 0.144 (64.40)$$

$$= 9.27 \text{ cm}$$

<u>For DEC</u>

$$Cu/AET = \frac{0.8 \times 7.15}{40} (1.8 \times 15 + 32)$$

$$= 8.43 \text{ cm}$$

<u>For JAN</u>

$$Cu/AET = \frac{0.8 \times 7.30}{40} (1.8 \times 13.5 + 32)$$

$$= 8.21$$

<u>For FEB</u>

$$Cu/AET = \frac{0.8 \times 7.10}{40} (1.8 \times 14.5 + 32)$$

$$= 8.25 \text{ cm}$$

Here,

$$\text{Total } C_u = 9.27 + 8.43 + 8.21 + 8.25$$

$$C_u = 34.16$$

→ Pan-coefficient

Pan evaporation $\times C_p$ = Actual evaporation

$$E_{pan} \times C_p = E_{act}$$

Similarlly

Pan evapotranspiration $\times C_p$ = Actual evapotranspiration = (AET/C_u)

$$ET_{pan} \times C_p = ET_{act}$$

or

$$ET_{pan} \times C_p = C_u$$

So,

$$\text{Evapotranspiration } (ET_{pan}) = \frac{C_u}{C_p}$$

$$= \frac{34.16}{0.8}$$ → crop factor as a pan factor

$$= 42.70 \text{ cm}$$

Now,

CIR (Consumptive irrigation requirement) = $C_u - R_e$ → Effe. rainfall

Here

$ER (Re) = 1.70 + 1.42 + 3.01 + 2.25$ (given)

$= 8.38$ cm

So,

$CIR = Cu - Re$

$= 34.16 - 8.38$

$= 25.78$ cm

&

Field irrigation requirement (FIR)
or
Gross irrigation requirement (GIR) $= \frac{NIR}{\eta_a}$

where
NIR = Net irrigation requirement
η_a = Application efficient (80% = 0.8 given)

Note:- Kept in mind CIR & NIR both are same

So,

$GIR = \frac{CIR}{\eta_a}$

$= \frac{25.78}{0.8}$

$= 32.22$ cm